

Appl. No. : 10/696,591  
Filed : October 28, 2003

#### REMARKS

Claims 1-34 are pending in the present application. Claims 1, 10, 12, 15, 17, 18 and 25 have been amended to their original form before the amendments of December 11, 2006. Claim 34 has been added to merely reinstate original Claim 14, which was canceled in the last amendment. Thus, no new matter has been added by these amendments.

#### Allowable Subject Matter

Claim 21 has been objected to as being dependent upon a rejected base claim but deemed allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims. Applicants thank the Examiner for allowable subject matter but respectfully refrain from rewriting Claim 21 at this time in view of the allowability of the other claims, as discussed below.

#### Claim Rejections Under 35 U.S.C. §103

Claims 1-20, 22-27 and 31-33 have been rejected under 35 U.S.C. §103 as unpatentable over Gordon et al. (PCT WO02/27063) in view of Hintermaier et al. (U.S. Patent No. 6,177,135). Claims 28-30 have been rejected under 35 U.S.C. §103 as unpatentable over Gordon et al. in view of Hintermaier et al., and further in view of Kil (U.S. Patent App. Pub. 2003/0124875). These rejections are traversed.

Applicants submit that Gordon et al. fails to disclose a “process for producing a multicomponent bismuth-containing oxide thin film by Atomic Layer Deposition,” as recited in independent Claim 1, a “process for depositing a bismuth oxide layer on a substrate by Atomic Layer Deposition,” as recited in independent Claim 10, and a “process for forming a bismuth-containing multicomponent oxide thin film by Atomic Layer Deposition,” as recited in independent Claim 26. Applicants also submit the following.

#### A *prima facie* case for obviousness has not been established

In order to establish a *prima facie* case of obviousness, the references when combined must teach or suggest all of the claim limitations. The Examiner bears the initial burden of

factually supporting any prima facie conclusion of obviousness. M.P.E.P. § 2142. Applicants submit that the Examiner has not established a *prima facie* case of obviousness for failing to disclose each and every limitation of independent Claims 1, 10 and 26.

In rejecting independent Claims 1 and 10, the Examiner alleges that Gordon et al. discloses a process for producing a bismuth-containing oxide thin film by Atomic Layer Deposition (ALD) on page 1, lines 1-3 and 23-24, and an organic bismuth compound containing at least one silylamido ligand as a source material for the thin film in Table 1. In rejecting independent Claim 26, the Examiner alleges that Gordon does not explicitly disclose combining a bismuth compound with a silylamido ligand with at least a second metal precursor to form a bismuth-containing multicomponent oxide, but that Hintermaier teaches forming bismuth-containing multicomponent oxides in order to make oxide films with ferromagnetic properties. Applicants respectfully disagree.

The Examiner states on p. 2 of the Office Action in response to Applicants' previous arguments that although "Gordon et al. gives a bismuth oxide film as one of the many examples in Table 1, it still discloses making a bismuth oxide film." Applicants disagree and would like to clarify that Gordon et al. *does not* actually disclose a "bismuth *oxide film*" in Table 1 as alleged in the Office Action. Instead, Table 1 of Gordon et al. is entitled "Some Volatile Metal or Metalloid Amides," and accordingly only discloses *precursors* (Gordon et al., p. 16). To the extent that the Examiner regards *precursors* as equivalent to *oxide films*, Applicants submit that precursors can be used in reactions to form various films *other than oxides*, such as silicates, phosphates, and other mixed metal films as sufficiently disclosed throughout Gordon et al. Thus, *precursors* do not automatically imply and are not in any way "examples" of *oxide films*, contrary to the Examiner's allegation. Accordingly, Applicants submit that the metals or metalloid amides listed as *precursors* in Table 1 *do not* disclose an "*oxide thin film*," as recited in Claim 1, an "*oxide layer*," as recited in Claim 10, or a "*multicomponent oxide thin film*," as recited in Claim 26.

Applicants also note that Gordon et al. generally refers to the deposition of metal oxides, silicates, metal phosphates or silicon dioxide by CVD or ALD, and also specifically discloses ALD processes for forming certain films. However, Gordon et al. *does not specifically disclose an ALD process for forming bismuth oxides*, as recited in Claims 1, 10 and 26. Instead, Gordon

et al. merely discloses *two bismuth precursors*,  $\text{Bi}(\text{N}(\text{SiMe}_3)_2)_3$  and  $\text{Bi}(\text{N}(\text{Me})(\text{SiMe}_3))_3$ , in Table 1, which lists almost 150 volatile metal or metal amides from various sources of literature as “examples” of volatile compounds (see p. 16, lines 1-3). However, there is no specific teaching anywhere in Gordon et al. that the two bismuth precursors listed in Table 1 can *actually be used* in an ALD process for producing a bismuth-containing oxide thin film, as recited in Claim 1, for depositing a bismuth oxide layer on a substrate by ALD, as recited in Claim 10, and for forming a bismuth-containing multicomponent oxide thin film by ALD, as recited in Claim 26.

Applicants also note that while Gordon et al. does not specifically disclose any workable process of ALD deposition of a *bismuth oxide*, Gordon et al. reports in detail successful results of ALD for many *other precursors*. These ALD processes *specifically disclosed* in Gordon et al. include the ALD deposition of silicon dioxide (p. 13, lines 7-10), hafnium oxide (p. 25, lines 1-15), zirconium silicate (p. 33, lines 12-16), hafnium silicate (p. 33, lines 22-25), yttrium silicate (p. 34, lines 7-11), lanthanum silicate (p. 34, lines 17-20), lithium phosphate (p. 35, lines 9-12), zirconium oxide (p. 34, lines 3-5), tantalum oxide (p. 39, lines 9-12), aluminum phosphate (p. 39, lines 13-17), aluminum silicate (p.39, line 18 to p. 41, line 4) and lanthanum oxide (p. 41, lines 12-14). However, there is *no discussion* in Gordon et al. on any ALD process for forming a bismuth oxide, or any teaching of how the specific ALD process conditions set forth for any of the *other precursors* could be altered to deposit bismuth-oxide films. Not only does Gordon et al. fail to provide particular reactions conditions that could enable ALD deposition of bismuth-oxide films, Gordon et al. does not even suggest the desirability of depositing bismuth-containing oxide films by ALD. Thus, Applicants submit that Gordon et al. *does not disclose* an ALD process for forming bismuth oxide films, unlike the Examiner’s allegation in the Office Action.

Applicants submit that Hintermaier et al. fails to cure the deficiency. Hintermaier only teaches *CVD processes* for depositing bismuth-containing thin films (see, e.g., Abstract). There is no teaching or suggestion anywhere in Hintermaier et al. of any ALD process, no less an ALD process for forming bismuth oxide films.

Thus, Applicants submit that a *prima facie* case has not been established because the cited art, together or alone, fails to disclose a “process for producing a multicomponent bismuth-containing oxide thin film by Atomic Layer Deposition (ALD),” as recited in Claim 1, a “process for depositing a bismuth oxide layer on a substrate by Atomic Layer Deposition (ALD),” as

recited in Claim 10, and a “process for forming a bismuth-containing multicomponent oxide thin film by Atomic Layer Deposition (ALD),” as recited in Claim 26.

There is no reason to modify or combine the references to arrive at the claimed methods

In the Court’s recent decision in *KSR International Co. v. Teleflex Inc.*, 550 U.S. \_\_\_\_\_ (2007), the Court repeatedly emphasized the value of determining if there is any “reason to combine” the various teachings in the art. The Court noted that “[a] patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art.” (*KSR*, Syllabus, page 4 and page 14). The Court has made it clear that some reason to combine the various elements must be present in order to establish a *prima facie* case of obviousness.

As set forth above, Gordon has no explicit teaching of *ALD* formation of a *bismuth-containing oxide* and recites only two bismuth precursors. Hintermaier discloses only *CVD processes* for depositing multicomponent bismuth-containing films. Gordon et al. further does not have any particular teaching about the desirability of depositing bismuth-containing oxide films by ALD processes, and Hintermaier does not suggest that the films they deposit by CVD are lacking in some way such that they would benefit from deposition by ALD. Accordingly, Applicants submit that *no reason* has been provided to modify the disclosure of Gordon et al. to provide for depositing a bismuth-containing oxide film by ALD methods, or to combine the disclosures of Gordon et al. and Hintermaier et al. to produce the multicomponent bismuth-containing films described in Hintermaier et al. by ALD methods.

As previously noted by the Applicants, CVD processes work on very different principles from ALD and are not interchangeable with ALD processes. See, for example, the Abstract of Hintermaier, which teaches that the CVD reactions are based on *decomposition* of precursors at the substrate surface. In contrast, ALD conditions are chosen to *avoid decomposition* and achieve the self-limiting reactions that are the trademark of ALD. In particular, ALD utilizes self-saturating surface reactions and thus depends upon the particular nature of the precursors used and selection of particular reaction conditions. Importantly, there is no universal set of conditions under which ALD will work. instead, particular deposition recipes must be developed

for each type of film to be deposited. Not all precursors are suitable for ALD, and the precursors are chosen based on the particular context.

Accordingly, Applicants submit that without a particular reason, it would not have been automatically obvious to modify Gordon et al. or combine the teachings of Gordon et al. with Hintermaier et al., since bismuth precursors as may be used for CVD are *not automatically useful for ALD*. Applicants submit that the absence of a reason to select ALD methods is particularly noticeable here since films are grown monolayer by monolayer using ALD, and thus have reduced throughput, which increases costs. Thus, without a particular reason to utilize ALD, the skilled artisan would typically select a process with a higher throughput and reduced cost, such as CVD methods.

Accordingly, Applicants respectfully submit that a reason to combine the references has not been provided.

There is no expectation of success in the claimed methods

Even if there were a teaching generally in the art of the desirability of depositing a particular film, such as a multicomponent bismuth containing oxide by ALD, such a suggestion does not render obvious the particular ALD methods that must be developed to deposit that film. There must be an expectation of success in the combination. Applicants submit that because ALD is a very different process from CVD, and because not all CVD precursors work automatically for ALD methods, there is *no reasonable expectation of success* in the Examiner's proposed combination.

Applicants attach herewith an article by Leskela et al. ("ALD precursor chemistry: Evolution and future challenges") which specifically teaches that ALD is "unique" and that reaction properties required of ALD are different from those of CVD such that the selection of precursors *would not be the same* for both processes (*see, e.g.*, Pr8-839). Indeed, the first line in the Abstract states precisely this position: "The *requirements of ALD precursors differ from those of CVD* concerning thermal stability, adsorption on the surface, and reactions towards each other." (Abstract, emphasis added). For example, Leskela et al. teaches that "[t]he *difference to CVD chemistry is clear* since ALD favours precursor combinations, for example trimethyl-aluminum (TMA) + water, zinc chloride + hydrogen sulfide, *which in CVD can not be mixed*

together and introduced simultaneously into the reactor.” (Pr8-839, paragraph 1, emphasis added).

Applicants also note that even Gordon et al. concedes that efficiency and deposition speed for ALD deposition using a particular hafnium precursor was “surprising” because the same hafnium precursor has been known in the art to not provide uniform deposition of hafnium oxide (p. 25). If even Gordon et al. admits that ALD film growth results are “surprising” for certain precursors, Gordon et al. also suggests that *not all precursors are automatically useful* for ALD methods.

Thus, Applicants maintain that the skilled artisan would have known that ALD is a unique and very different process from CVD, such that precursors that are useful for CVD *are not automatically useful for ALD*, unlike the Examiner’s assumption. Thus, Applicants submit that the skilled artisan would *not have expected success* in the claimed methods.

The claimed methods provide unexpected results

Unexpected results can rebut a *prima facie* case of obviousness because that which would have been surprising to a person of ordinary skill in a particular art would not have been obvious. *In re Soni*, 54 F.3d 746 (Fed. Cir. 1995). As noted above, Applicants disagree that the Examiner has established a *prima facie* case of obviousness. However, even assuming that a *prima facie* case of obviousness has been established, Applicants submit that the unexpected results of the claimed methods discussed below weighs strongly in favor of a finding of nonobviousness.

For example, as discussed in the present Application, silylamides are not known in the art for being particularly stable, and that there was no teaching in the art otherwise (*Application*, paragraph [0011]). Only Applicants have found that the claimed bismuth compounds having at least one “silylamido ligand,” as recited in Claim 1, “bis(trialkylsilyl)amido ligand,” as recited in Claim 10, and “bis(trialkylsilyl)amido ligand” as recited in Claim 26, can be successfully used as precursors for forming bismuth-containing oxide films (binary as well as multicomponent oxides) by ALD. Given the knowledge in the art, this “finding was *surprising*” (*Application*, paragraph [0011]). Thus, Applicants submit that the skilled artisan *would not* have been led to use the claimed silylamide precursors in ALD methods. Asserting that the skilled artisan would have used the claimed precursors in ALD, when silylamides were known in the art for being

unstable, would reflect a logic that is only supportable by hindsight. Applicants submit that this very type of hindsight reasoning is impermissible (*see* MPEP 2145).

Since only Applicants have discovered the surprising results of bismuth-containing oxide films from using the claimed bismuth precursors in the claimed ALD methods. Applicants submit that these ***unexpected results*** are entitled patentable weight. Thus, Applicants submit that it would not have been obvious to modify the cited art as alleged in the Office Action, especially in light of the unexpected results of the claimed methods. Applicants submit that Applicants' clear showing of these unexpected results overcome any *prima facie* case of obviousness.

For at least the forgoing reasons, Applicants respectfully request withdrawal of the rejection to independent Claims 1, 10 and 26, and Claims 2-9, 11-25 and 27-34, which depend respectively therefrom.

*No Disclaimers or Disavowals*

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, the Applicants are not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. The Applicants reserve the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that the Applicants have made any disclaimers or disavowals of any subject matter supported by the present application.

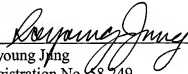
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Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

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By:   
Soyoung Jung  
Registration No. 58,249  
Attorney of Record  
Customer No. 20,995  
(415) 954-4114

3709359  
043007